Acromag®

Series 941X/946X

Digital I/O Board

USER'S MANUAL

ACROMAG INCORPORATED
30765 South Wixom Road
P.O. BOX 437
Wixom, MI 48393-7037 U.S.A.
Tel: (248) 624-1541
Fax: (248) 624-9234

8500-244-B97J006

The information in this manual is subject to change without notice. Acromag, Inc., makes no warranty of any kind with regard to this material, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. Further, Acromag, Inc., assumes no responsibility for any errors that may appear in this manual and makes no commitment to update, nor keep current, the information contained in this manual.

No part of this manual may be copied or reproduced in any form, or by any means, without the prior written consent of Acromag, Inc.

IMPORTANT SAFETY CONSIDERATIONS

It is very important for the user to consider the possible adverse effects of power, wiring, component, sensor or software failures in designing any type of control or monitoring system. This is especially important where economic property loss or human life is involved. It is important that the user employ redundancy, and comprehensive failure analysis to insure a safe and satisfactory overall system design. It is agreed between the Buyer and Acromag, that this is the Buyer's responsibility.

Acromag, Inc.
30765 South Wixom Road
P.O. Box 437
Wixom, Michigan 48393-7037, USA

Tel: (248) 624-1541
Fax: (248) 624-9234

Copyright 1992, 1995 Acromag, Inc. Printed in USA
Data and specifications subject to change without notice

TABLE OF CONTENTS

CHAPTER

Page

1.0 GENERAL INFORMATION..... 4
1.1 INTRODUCTION..... 4
1.2 FEATURES OF THE AVME946X..... 4
1.3 FEATURES OF THE AVME941X..... 4
1.4 VMEbus INTERFACE FEATURES..... 5

2.0 PREPARATION FOR USE..... 5
2.1 UNPACKING AND INSPECTION..... 5
2.2 CARD CAGE CONSIDERATIONS..... 5
2.3 BOARD CONFIGURATION..... 6
2.3.1 Default Jumper Configuration..... 6
2.4 ADDRESS ASSIGNMENT..... 6
2.5 JUMPER AND OPTIONS..... 8
2.6 I/O CONNECTIONS..... 8
2.7 BACKPLANE REQUIREMENTS..... 11
2.8 USE WITH SOLID STATE RELAYS..... 12
2.8.1 Configuring the AVME94XX..... 12
2.8.2 Configuring the PB16A..... 12
2.9 USE WITH OTHER DEVICES..... 12
2.9.1 Relays and Other Inductive Loads..... 12
2.9.2 Contact Closures and Switches..... 13

3.0 PROGRAMMING INFORMATION..... 13
3.1 MEMORY MAP..... 13
3.1.1 Board Identification PROM..... 14
3.1.2 Board Status Register..... 15
3.1.3 Digital I/O Port Registers..... 16
3.1.4 Digital Output Register..... 16

4.0 THEORY OF OPERATION..... 16
4.1 VMEbus INTERFACE..... 16
4.2 BOARD CONTROLLER..... 16
4.3 DIGITAL PORT SECTION..... 16

5.0 SERVICE AND REPAIR INFORMATION..... 17
5.1 SERVICE AND REPAIR ASSISTANCE..... 17
5.2 PRELIMINARY SERVICE PROCEDURE..... 17
5.3 PARTS LISTS..... 17

6.0 SPECIFICATIONS..... 19

FIGURES:

2.1 AVME94XX JUMPER LOCATION DRAWING (4500-949)..... 20
2.2 9921-16 CONNECTION DIAGRAM (4500-790)..... 21
2.3 9921-32 CONNECTION DIAGRAM (4500-791)..... 22
2.4 AVME946X CONNECTION DIAGRAM (4500-950)..... 23
2.5 9921-16 DIGITAL I/0 ADAPTER CARD (4500-788)..... 24
2.6 9921-32 DIGITAL I/0 ADAPTER CARD (4500-789)..... 25
2.7 RELAY DRIVER CONFIGURATIONS (4500-743)..... 26
2.8 INPUT CONFIGURATIONS(4500-743)..... 26
4.1 AVME946X/941X BLOCK DIAGRAM.(4500-948)..... 27
4.2 SIMPLIFIED I/O POINT SCHEMATIC (4500-947)..... 28

AVME946X/941X SCHEMATIC & PART LOCATION DRAWING (4500-946)..... 29

1.0 GENERAL INFORMATION

1.1 INTRODUCTION

This manual covers eight models of digitial boards. Table 1.1 lists the model numbers and their major differences.

MODEL	INTERACE POINTS	FRONT PANEL ACCESS	REAR ACCESS
AVME9460	64 I/O	P3, P4, P5, P6	P2
AVME9461	64 I/O		
AVME9462	32 I/O	P3, P4	
AVME9463	32 I/O		P2
AVME9410	64 OUTPUTS	P3, P4, P5, P6	
AVME9411	64 OUTPUTS		P2
AVME9412	32 OUTOUTS	P3, P4	
AVME9413	32 OUTPUTS		P2

General Features

The AVME946X Digital Input/Output (I/O) Board provides a means for interfacing various discrete devices to a VMEbus based computer. Interfacing is accomplished by 32 or 64 general purpose I/O points which under software control may be individually programmed to be inputs or outputs.

1.2 FEATURES OF THE AVME 946X

- 32 or 64 programmable I/O points (lines) configured as 4 or 8 - 8 bit ports or 2 or 4 - 16 bit ports all with inverted logic.
- Can read the state of points configured as outputs.
- Outputs sink up to 100 mA, from an external 5V supply.
- Built in protection diodes for driving relay coils.
- Input hysteresis.
- Compatible with industry standard solid state relays and termination panels, PB16 and PB32. AVME 9460 and 9462 provide direct connection to the PB16 termination panel, no adapter boards necessary. Optional universal termination panel available for use with contact closures, relays, incandescent lamps.
- TTL and CMOS compatible.
- Byte or word data transfers.
- Board identification PROM.
- Pass/Fail Status indicators on the front panel.
- I/O accessible through the front panel or out of the back of the card cage.

1.3 FEATURES OF THE AVME 941X

The AVME941X Digital Output Board provides a means for interfacing various discrete devices to a VMEbus based computer. Interfacing is accomplished by 32 or 64 output points.

The AVME 941X Digital Output Board features:

- 32 or 64 programmable Output points (lines) configured as 4 or 8 - 8 bit ports or 2 or 4 - 16 bit ports all with inverted logic.
- Outputs sink up to 100 mA, from up to a 30V external source.
- Built in protection diodes for driving relay coils.

Compatible with industry standard solid state relay termination panels, PB16 and PB32. AVME 9410 and 9412 provide direct connection to the PB16 termination panel, no adapter boards necessary. Optional universal termination panel available for use with contact closures, relays, incandescent lamps.

- TTL and CMOS compatible.
- Byte or word data transfers.
- Board identification PROM.
- Pass/Fail Status indicators on the front panel.
- I/O accessible through the front panel or out of the back of the card cage.

1.4 VMEbus INTERFACE FEATURES

- Slave module A24/A16, D16/D08 (EO).
- Short I/O Address Modifiers 29H, 2DH (H = Hex).
- Standard Address Modifiers 39H, 3DH (H = Hex).
- I(1-7) interrupter, jumper programmable interrupt level, software programmable interrupt vectors (for digital input channels 0-7), interrupt release mechanism is Release On Register Access (RORA) type.
- Decode on 1K byte boundaries.

2.0 PREPARATION FOR USE

This chapter provides information about preparing the Isolated Digital I/O Board for system operation.

2.1 UNPACKING AND INSPECTION

Inspect the shipping carton immediately upon receipt for evidence of mishandling during transit. If the shipping carton is severely damaged or water stained, request that the carrier's agent be present when the carton is opened. If the carrier's agent is absent when the carton is opened and the contents of the carton are damaged, keep the carton and packing material for the agent's inspection.

For repairs to a product damaged in shipment, refer to the Acromag Service Policy to obtain return instructions. It is suggested that salvageable shipping cartons and packing material be saved for future use in the event the product must be shipped.

The board is physically protected with foam and electrically protected with an antistatic bag during shipment. It is advisable to visually inspect the board for evidence of mishandling prior to applying power.

CAUTION
SENSITIVE ELECTRONIC DEVICES
USE ANTI-STATIC HANDLING PROCEDURES

2.2 CARD CAGE CONSIDERATIONS

Refer to the specifications for bus loading and power requirements. Be sure that the system power supplies are able to accommodate the additional requirements within the voltage tolerances specified.

Adequate air circulation must be provided to prevent a temperature rise above the maximum operating temperature. Large and continuing fluctuations in ambient air temperature should be avoided. If the installation is in an industrial environment and the board is exposed to environmental air, careful consideration should be given to air filtering.

2.3 BOARD CONFIGURATION

The Digital I/O Board may be configured in a variety of ways for many different applications. Each possible jumper setting will be discussed in the following sections. The jumper locations are shown in Figure 2.1.

2.3.1 Default Jumper Configuration

VMEBUS INTERFACE CONFIGURATION

When a board is shipped from the factory, it is configured as follows:

- VMEbus Short I/O Address of 0000H.
- Set to respond to both Address Modifiers 2DH.

2.4 ADDRESS ASSIGNMENT

Jumpers J17, J18, and J19 are used to establish the base address for the 1k byte block of memory the AVME 94XX will occupy in the Memory Map. J17 and J18 selects the base address. An open, or no jumper installed, corresponds to a logic 0 state. Refer to Table 2.2 Address Decoding. J19 selects the address modifier codes and the Standard or Short Memory Map. An open on J19 pins 1 and 2 selects only the Supervisory Access (3DH or 2DH) code. A short on J19 pins 1 and 2 will allow the card to recognize both the Supervisory and the Non-Priviledged Access codes. An open, or no jumper installed, on J19 pins 3 and 4 selects Short Memory Map. A short, or jumper installed, selects Standard Memory Map. Refer to Table 2.1.

Table 2.1 VMEbus Address Modifier Codes

Jumper J19		**Address Modifier Codes Recognized**	**Addressing Mode**
Pins 3 & 4	**Pins 1 & 2**		
OUT	OUT	2DH	Short Supervisory
OUT	IN	2DH OR 29H	Short Supervisory or Short Non-Priveledged
IN	OUT	3DH	Standard Supervisory
IN	IN	3DH OR 39H	Standard Supervisory or Standard Non-Priveledged

Table 2.2 VMEbus Address Decoding

Jumper J19 Pins 3 & 4 - No Jumper Installed - Selecting The Short Memory Map. J18 Has No Effect On The Base Address Selection.

Pins of J17						
BASE ADDR (HEX)	**S15 (11 & 12)**	**S14 (10 & 9)**	**S13 (8 & 7)**	**S12 (6 & 5)**	**S11 (4 & 3)**	**S10 (2 & 1)**
0000	OUT	OUT	OUT	OUT	OUT	OUT
0400	OUT	OUT	OUT	OUT	OUT	IN
0800	OUT	OUT	OUT	OUT	IN	OUT
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
F400	IN	IN	IN	IN	OUT	IN
F800	IN	IN	IN	IN	IN	OUT
FC00	IN	IN	IN	IN	IN	IN

Pins of J18								
BASE ADDR (HEX)	**S23 (15&16)**	**S22 (13&14)**	**S21 (11&12)**	**S20 (9&10)**	**S19 (7&8)**	**S18 (5&6)**	**S17 (3&4)**	**S16 (1&2)**
000000	OUT	OUT	OUT	OUT	OUT	OUT	OUT	OUT
010000	OUT	OUT	OUT	OUT	OUT	OUT	OUT	IN
020000	OUT	OUT	OUT	OUT	OUT	OUT	IN	OUT
030000	OUT	OUT	OUT	OUT	OUT	OUT	IN	IN
.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.
FC0000	IN	IN	IN	IN	IN	IN	OUT	OUT
FD0000	IN	IN	IN	IN	IN	IN	OUT	IN
FE0000	IN	IN	IN	IN	IN	IN	IN	OUT
FF0000	IN	IN	IN	IN	IN	IN	IN	IN

2.5 JUMPERS AND OPTIONS

Several jumpers have been included to allow for flexible interfacing to external devices. Table 2.3 describes the various jumpers and their functions.

TABLE 2.3 Jumper Descriptions

Jumper	Function	Condition as shipped
J2 J4 J6 J10	Port pullup voltage jumper. When in placem pulls the I/O lines to +5V through the removable pullup networks.	Jumpers in place
J9 J7 J5 J15 J3 J13 J1 J11	Port N+0 output driver enable Port N+1 output driver enable Port N+2 output driver enable Port N+3 output driver enable Port N+4 output driver enable Port N+5 output driver enable Port N+6 output driver enable Port N+7 output driver enable	J1-15 Odd. made with a thin trace on solder side. Cutting a jumper will disable that group of 8 ouputs.

J1 - J15 Odd, are used only in cases where it is absolutely necessary to have outputs disabled through hardware. See section 3.5, Programming Considerations, for software enabling/disabling of outputs.

2.6 I/O CONNECTIONS

On Model AVME94X1, the 64 I/O points are accessible through a 96 pin Din 41612 connector labeled P2.

CAUTION
DO NOT PLUG P2 INTO ANY BACKPLANES IN A CARD CAGE!

I/O adapter cards (Model 9921-16 or 9921-32) are used to interface between P2 and the ribbon cables. These adapters mount to the back of a VME cage to provide the mating socket for P2. Refer to termination panel connection diagrams, figure 2.2 and 2.3.

On Model AVME94X0, four 50-pin ribbon cable connectors (labeled P3, P4, P5 and P6) on the front panel are used to access the 64 I/O points. Refer to the termination panel connection diagram figure 2.4.

Refer to Table 2.4 for the I/O Connector Pin Assignments.

Table 2.4 I/O Connectors P2, P3, P4, P5 & P6

Functions	P2 Pin #	P3 Pin #	P4 Pin #
Port N+0 I/O Bit 7	B25	33	
6	B26	35	
5	B27	37	
4	B28	39	
3	B29	41	
2	B30	43	
1	B31	45	
0	B32	47	
Port N+1 I/O Bit 7	B17	17	
6	B18	19	
5	B19	21	
4	B20	23	
3	B21	25	
2	B22	27	
1	B23	29	
0	B24	31	
+5V	B9	1,49	
GND	B13,B14	2 thru 50	
GND	B15,B16	Even	
Pullup Ports 0 & 1	B11	5	
Protect Ports 0 & 1	B10	3	
Port N+2 I/O Bit 7	A25		33
6	A26		35
5	A27		37
4	A28		39
3	A29		41
2	A30		43
1	A31		45
0	A32		47
Port N+3 I/O Bit 7	A17		17
6	A18		19
5	A19		21
4	A20		23
3	A21		25
2	A22		27
1	A23		29
0	A24		31
+5V	B1		1,49
GND	B5,B6		2 thru 50
GND	B7,B8		Even
Pullup Ports 2 & 3	B3	6	5
Protect Ports 2 & 3	B2	4	3

Table 2.4 Continued

Functions	P2 Pin #	P5 Pin #	P6 Pin #
Port N+4 I/O Bit 7	C25	33	
6	C26	35	
5	C27	37	
4	C28	39	
3	C29	41	
2	C30	43	
1	C31	45	
0	C32	47	
Port N+5 I/O Bit 7	C17	17	
6	C18	19	
5	C19	21	
4	C20	23	
3	C21	25	
2	C22	27	
1	C23	29	
0	C24	31	
+5V	C9	1,49	
GND	C15,C16	2 thru 50	
GND	C13,C14	Even	
Pullup Ports 4 & 5	C11	5	
Protect Ports 4 & 5	C10	3	
Port N+6 I/O Bit 7	A8		33
6	A7		35
5	A6		37
4	A5		39
3	A4		41
2	A3		43
1	A2		45
0	A1		47
Port N+7 I/O Bit 7	A16		17
6	A15		19
5	A14		21
4	A13		23
3	A12		25
2	A11		27
1	A10		29
0	A9		31
+5V	C1		1,49
GND	C5,C6		2 thru 50
GND	C7,C8		Even
Pullup Ports 6 & 7	C3		5
Protect Ports 6 & 7	C2		3

2.7 BACKPLANE REQUIREMENTS

The AVME94XX is electrically and mechanically compatible with the VMEbus Specification Manual, Revision C. The backplane connection is made through the 96 pin DIN 41612 connector labeled P1. The signals used are listed in Table 2.5.

Table 2.5 Backplane Connector P1

Pin Number	Row A Signal Mnemonic	Row B Signal Mnemonic	Row C Signal Mnemonic
1	D00		D08
2	D01		D09
3	D02		D10
4	D03		D11
5	D04		D12
6	D05		D13
7	D06		D14
8	D07		D15
9	GND		GND
10	SYSCLK		SYSFAIL*
11	GND		BERR*
12	DS1*		SYSRESET*
13	DS0*		LWORD*
14	WRITE*		AM5
15	GND		A23
16	DTACK*	AM0	A22
17	GND	AM1	A21
18	AS*	AM2	A20
19	GND	AM3	A19
20	IACK*	GND	A18
21			A17
22			A16
23	AM4	GND	A15
24	A07		A14
25	A06		A13
26	A05		A12
27	A04		A11
28	A03		A10
29	A02		A09
30	A01		A08
31			
32	+5V	+5V	+5V

2.8 USE WITH SOLID STATE RELAYS

The AVME 94XX Digital I/O Board may interface with industry standard solid state relays and termination panels PB16A, PB32 and their equivalents.

2.8.1 Configuring The AVME - 94XX

On the AVME94XX, the following jumpers or shorting clips should be in place: J2, J4, J6 and J10. Pullup resistor networks R1, R2, R3, R4, R5, R6, R7 and R8 are removable.

Table 2.6 lists the Module Number Bit Positioning for the I/O port registers.

TABLE 2.6 Module Number Bit Positioning

I/O Port Number	Module Number 7 6 5 4 3 2 1 0	PB16A connected to
N+0	7 6 5 4 3 2 1 0	P3
N+1	15 14 13 12 11 10 9 8	P3
N+2	7 6 5 4 3 2 1 0	P4
N+3	15 14 13 12 11 10 9 8	P4
N+4	7 6 5 4 3 2 1 0	P5
N+5	15 14 13 12 11 10 9 8	P5
N+6	7 6 5 4 3 2 1 0	P6
N+7	15 14 13 12 11 10 9 8	P6

For bit positions corresponding to output modules, a 1 state will turn the I/O point on and the output latch will sink current. A 0 state will turn the module off. For bit positions corresponding to input modules, a 1 state indicates the presence of a low voltage for the "on" state of the module.
A 0 state indicates a high voltage present.

2.8.2 Configuring The PB16A

If the PB16A is to get power from the AVME94XX, install a jumper at pin 1 or pin 49 on the PB16A termination panel. Install appropriate solid state relay modules. Connect the 50 Pin ribbon cable between PB16A and the AVME94XX observing the pin 1 index mark.

2.9 USE WITH OTHER DEVICES

The AVME946X/941X Digital Boards can interface with a variety of discrete devices such as relays, switches, contact closures, and indicators. Optional termination panel 6980-16U can be used to connect field wiring to the digital I/O card. The following guidelines should be followed to insure proper interfacing.

2.9.1 Relays And Other Inductive Loads

When driving relays coils or other inductive loads, the PROTECT line should be tied to the voltage supply of the loads. This puts a diode accross each load to limit the voltage spike generated when an inductive load is switched off quickly. Since PROTECT is common to all 16 outputs, the supply voltage for all of the loads must be the same. Otherwise, each load will have to have its own external diode. The pullup resistors should be removed from the digital I/O card also. See figure 2.7 Relay Driver and Input Configurations, for relay driver configurations.

2.9.2 Contact Closures And Switches

When sensing contact closures that already are connected to a voltage source the pullup resistor networks should be removed. The input voltage should be within the range listed in Specifications, Section 6. For isolated or grounded contacts the pullups and the +5 volt supply can be used to establish an input voltage. See figure 2.8 Relay Driver and Input Configurations, for various input configurations.
This chapter provides the specific information necessary to program the
Digital I/O Board.

3.0 PROGRAMMING INFORMATION

3.1 The Digital I/O Memory Map

The memory map for the Digital I/O Board, a Non-Intelligent I/O architecture is shown in Figure 3.1. All addresses are in hexadecimal. The letters R and W indicates whether a register may be read and/or written to. The areas marked "undefined" in the memory map are reserved for future use. To allow future compatibility, application programs must not use these areas.

Figure 3.1 AVME94XX Digital I/O Board Memory Map.

Address Base + (HEX)	Even	Odd	Address Base + (HEX)
00 ↓ 3E	Undefined	R - Module ID PROM	01 ↓ 3f
40 ↓ 7E	Undefined		41 ↓ 7F
80	Undefined	R/W - Status/Control	81
82 ↓ FE	Undefined		83 ↓ FF
100	R/W - I/O Port 0	R/W - I/O Port 1	101
102	R/W - I/O Port 2	R/W - I/O Port 3	103
104	R/W - I/O Port 4	R/W - I/O Port 5	105
106	R/W - I/O Port 6	R/W - I/O Port 7	107
108 ↓ 3FE	Undefined		109 ↓ 3FF

Note: For AVME 941X I/O Ports 0-7 are Write Only.
Note: Ports 4 through 7 present only on Models AVME 9410, 9411,9460, 9461.

3.1.1 Board Identification PROM (I.D. PROM) - (Read Only) (01-3F)

The Board Identification PROM occupies the 32 odd bytes beginning at location 01. These bytes contain ASCII character strings that identify various characteristics of the board. See figure 3.2.

Figure 3.2: Digital Board Identification PROM

Offset From Board Base Address	Value		Descriptions
	ASCII Character	Numeric	
01H	V	56H	Always VMEID for all boards.
03H	M	4DH	
05H	E	45H	
07H	I	49H	
09H	D	44H	
0BH	A	41H	Manufacturers I.D., ACR for ACROMAG.
0DH	C	43H	
0FH	R	52H	
11H	9	39H	Board Model Number (7 characters,
13H	4	34H	blank filled).
15H	1	31H	
17H	0	30H	
19H		20H	
1BH		20H	
1DH		20H	
1FH	1	31H	Number of Kilobytes of address space used.
21H		20H	Major functional revision level.
23H	1	31H	
25H	0	30H	Minor functional revision level.
27H		20H	
29H	Undefined		Reserved
2BH	Undefined		
2DH	Undefined		
2FH	Undefined		
31H	Undefined		
33H	Undefined		
35H	Undefined		
37H	Undefined		
39H	Undefined		
3BH	Undefined		
3DH	Undefined		
3FH	Undefined		

3.1.2 Board Status Register - (read/write) - 81H

The Board Status Register reflects and controls functions globally on the board.

MSB 7	6	5	4	3	2	1	LSB 0
<------ Reserved ------>			Software Reset	<------ Reserved ------>	.	Green LED	Red LED

Where:

Bits 7,6,5,3,2: Reserved for future use - equal "0" if read.

Bit 4: Software Reset (W) - writing a "1" to this bit causes a software reset. Writing "0" or reading the bit has no affect. A software reset turns all of the ports off which effectivly programs the ports for inputs.

Bit 1: Green LED (R/W) - this bit when written will control the state of the green LED on the front panel. A "1" will turn it on, a "0" will turn it off. Reading it will reflect its current state.

Reset Condition: Will read a "0", LED off.

Bit 0: Red LED (R/W) - this bit when written will control the state of the red LED on the front panel and the state of the VMEbus SYSFAIL* signal. A "1" will turn it off and set SYSFAIL* high, a "0" will turn it on and set SYSFAIL* low. Reading it will reflect its current state.

Reset Condition: Will read a "0", LED on, and SYSFAIL* is set low.

The status register bits 1 and 0 along with the green and red LEDs provide the user with a means of keeping track of a board's functionality in the system. Since there is no intelligence on the board, the host computer controls these bits. The following is one possible use of the bits in the status register and the LEDs on the front panel.

On power-up the bits in the status register will read low, with the green LED off, the red LED lit, and SYSFAIL* low. This indicates that the board has failed or that it hasn't been tested yet.

The Status Register Bit 1 reads low and Bit 0 reads high. The LEDs will both be off and SYSFAIL* is high. This indicates an inactive board.

The Status Register Bit 1 reads high and Bit 0 reads low. The LEDs will both be lit and SYSFAIL* is low. This indicates the board is undergoing a diagnostic checkout.

The Status Register Bits 1 and 0 read high. The green LED will be lit with the red LED off and SYSFAIL* is high. This indicates the board is fully functional.

3.1.3 Digital I/O Port Registers - (Read/Write) AVME 946X Only - (100-107)

The I/O Port Registers reflect and/or control the state of the bidirectional I/O points. Points are grouped 8 to a Port. To use a point as an input, write a "0" to it first to cause the output driver to go into an off (high impedance) state. That lets the point be pulled to a high voltage level by an onboard pull-up resistor. The point may then be driven by an external device. Reading the point will reflect the INVERTED level at the I/O connection. To use a point as an output, write the desired "1" or "0" to the point. If the point is read, it will reflect the state of the output as well. Note that because inverted logic is used, a high level at the I/O connection is read as a "0" in the Port Registers and a low level is read as a "1". This is consistant with the usage of open-collector outputs to drive

relays and switches. A logic "1" in the computer produces a low level at the output driver to "pull in" a relay and turn something "on", etc.

Reset Conditions: All of the I/O points are set to "0" which causes the output drivers to go into an off (hi-z) state. The result is that all I/O points are configured as inputs.

3.1.4 Digital Output Registers - (Write Only) AVME 941X Only - (100-107)

The Digital Output points are grouped 8 to a port. Writing a "1" to a point causes the open collector output to turn on, which will bring the output to a low state, sinking current from the output point. Writing a "0" to a point causes the open collector output to turn off, which will allow the pullup resistors to pull the output point to a high state.

Reset Conditions: All of the I/O points are in an off (high impedance) state.

4.0 THEORY OF OPERATION

This chapter describes the circuitry of the Digital Board. A block diagram of this board is shown in Figure 4.1. Schematics of the board are in chapter 7.

4.1 VMEbus Interface

The VMEbus Interface is composed of 3 functional areas:

- Data Buffers (U27, U28)
- Address Latch, Buffer and Comparators (U21, U3, U22, U24)
- Control Buffers (U25, U26)

4.2 Board Controller

The Board Controller is composed of 5 functions: (U19)

- Card and Register decoding
- VMEbus Interface controller
- PROM controller
- Status register
- Digital Port controller

4.3 Digital Port Section

The Digital Port is composed of an output latch and an input buffer. A simplified I/O point schematic is shown in figure 4.2.

- Output Latch (U1, U3, U5, U7, U9, U11, U13, U15)
- Input Buffer (Models AVME 946X only, U2, U4, U6, U8, U10, U12, U14, U16)

5.0 SERVICE AND REPAIR INFORMATION

This chapter provides instructions on how to obtain service and repair assistance, service procedures, and component parts lists.

5.1 SERVICE AND REPAIR ASSISTANCE

It is highly recommended that a non-functioning board be returned to Acromag for repair. Acromag uses tested and burned-in parts, and in some cases, parts that have been selected for characteristics beyond that specified by the manufacturer. Acromag has automated test equipment that thoroughly checks the performance of each board. When a board is first produced and when any repair is made, it is tested, placed in a burn-in room at elevated temperature, and retested before shipment.

Please refer to Acromag's Service Policy Bulletin or contact Acromag for complete details on how to obtain parts and repair.

5.2 PRELIMINARY SERVICE PROCEDURE

Before beginning repair, be sure that all of the procedures in Chapter 2, Preparation For Use, have been followed. The procedures are necessary since the board has jumpers that must be properly configured.

CAUTION
POWER MUST BE OFF BEFORE REMOVING OR INSERTING BOARDS

Note: It has been observed that on occasion, a "boot" program for a disk operating system will "hang" waiting for the VMEbus SYSFAIL* signal to be released by an intelligent disk controller board. Acromag's non-intelligent slave boards assert the SYSFAIL* signal as described in the VMEbus Specification Rev. C.1 and therefore, the disk operating system will remain "hung". The best solution to this problem is to correct the boot program so that it is no longer dependent upon the SYSFAIL* signal. When this solution is not practical, it is possible to disconnect the SYSFAIL* from the circuitry on the Acromag board by cutting a PC board foil near the P1 connector on the solder side. Caution should be exercised so as not to cut any other foils nor damage the board in any other way. Call Acromag's Applications Engineering Department for assistance.

5.3 PARTS LISTS

Parts Lists are provided as an aid to the user in troubleshooting the Board (also reference the schematic and part location drawings. Tables 5.1A to 5.1D list the parts installed on the main board for the various models; similarly Tables 5.2A to 5.2C list parts for the LED expansion board. Replacement parts and repair services are available from Acromag.

Changes are sometimes made to improve the product, to facilitate delivery, or to control cost. It is therefore important to include the Component Reference Number, the Acromag Part Number, the Board Model Number, and the Board Serial Number when providing information to order parts.

Table 5.1 Replaceable Parts

REFERENCE NO.	ACROMAG PART NUMBER	DESCRIPTION
U1,3,5,7,9,11,13,15	1033-515	UCN5801ABU
U2,4,6,8,10,12,14,16	1033-272	74LS24OND
U17	1033-358	2732A-3
U18	1033-278	74LS257AND
U19	1033-715	XC2018
U20	1033-263	74LS32ND
U21	1033-283	74LS373ND
U22, 24	1033-626	25LS2521PCB
U23, 25	1033-273	74LS244ND
U26	1033-623	74F38N
U27, 28	1033-627	74LS645-IND
R1,2,3,4,5,6,7,8,11	1100-268	RES NETWORK 9 4700 OHM
R9,10	1100-490	RES NETWORK 9 1K
C1-C18	1002-530	CAP MONO O.1UF
C19	1002-320	CAP TAN 1 UF
C20-C27	1002-315	CAP TAN 10UF
D1	1001-165	LED GREEN
D2	1001-166	LED RED
D3-D10	1001-168	DIODE NETWORK
F1	1030-496	FUSE 2 AMP.
P1,P2	1004-505	CONN. EDGE 96 MALE RT
P3,P5	1004-592	CONN. TWO 50 POS

6.0 SPECIFICATIONS

Operating Temperature	0 to +70 deg. C
Storage Temperature	-25 to +85 deg. C
Physical Characteristics:	(Double Eurocard)
Length	9.187 in. (233.3 mm)
Width	6.299 in. (160.0 mm)
Board Thickness	0.062 in. (1.59 mm)
Component Height	0.550 in. (13.97 mm)
Recommended Card Spacing	0.800 in. (20.32 mm)

Mating Connectors:

P1,P2	96 pin 603-2-IEC class 2
P3,P4	Panduit No. 100-532-033; Type B Male Connectors, rows A & B equipped,even pins only (32 pins total).

Power Requirements:

+ 5 Volts (+/-5%)	1.0A typical, 1.5A maximum
+ 12 Volts	0.0mA (no load)

VME BUS LOADING CURRENT	input low	input high
A23 - A10 A8 - A1	-0.4 mA	20 uA
AS*, IACK*, DS1*, DSO*, WRITE*, LWORD*, SYSCLK, SYSRESET* AM5 - AM0, A09	-0.2 mA	20 uA
D15 - D0.	-0.1 mA	20 uA

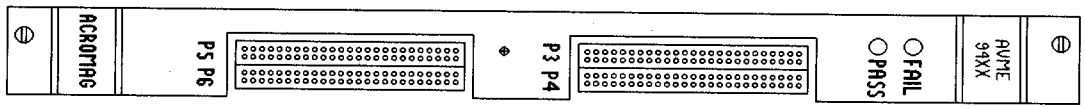
VME BUS DRIVE CURRENT	output low	output high
DTACK*, BERR*, SYSFAIL*	64 mA	-3.0 mA
D15 - D0	48 mA	-15 mA

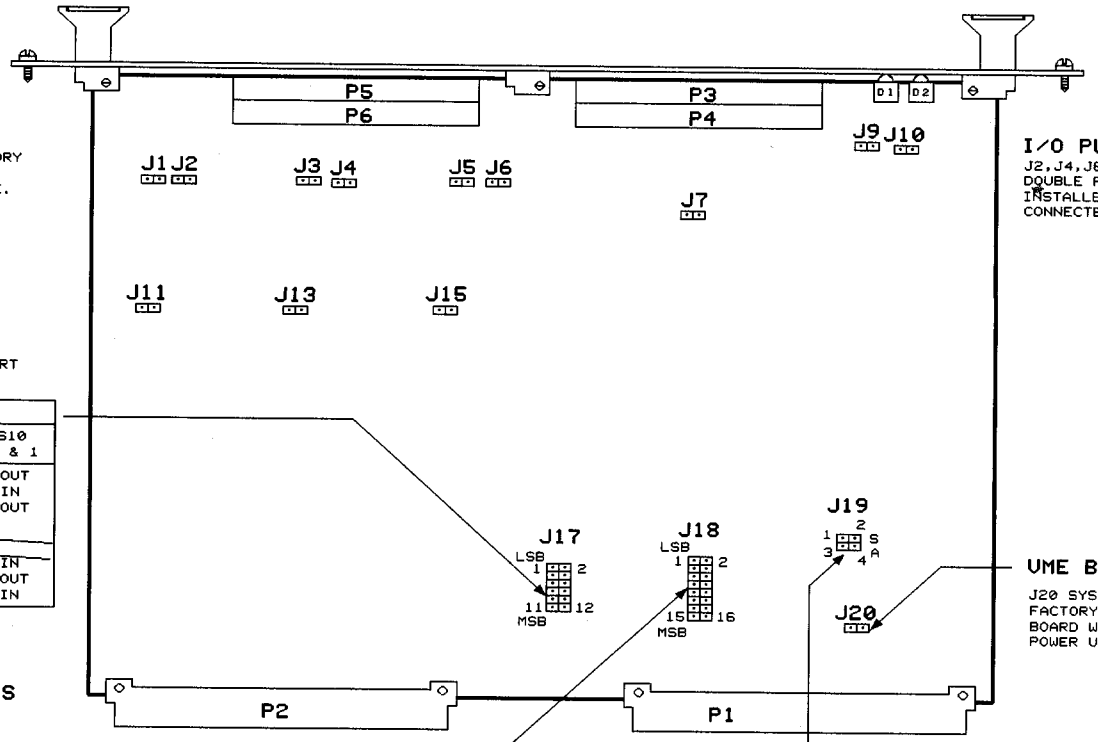
VME BUS ACCESS TIME <650nS

Measured from the falling edge of DSx* to the falling edge of DTACK*

DIGITAL INPUT/OUTPUT NON-ISOLATED

Input Voltage Range	0.0 to 5 V DC
Input Hysteresis	0.4 V DC nominal
Input Current	0.2 mA nominal
Points per Board AVME946X	32 or 64; each point can be configured as an input or an output
Points per Board AVME941X	32 or 64 outputs
Output Type	Open collector with removable pull up resistor
Output Voltage Range AVME946X	0 to 5 V DC
Output Voltage Range AVME941X	0 to 30 V DC
Output Current Sink	100 mA max. From an external supply. 24 mA max. From an internal supply.
Output Saturation Voltage - @ 100 mA	1.1 V max., 0.9V typ.
Logic Compatability	TTL, LSTTL, CMOS, and others.
Power Up to Stable Output Time	< 500 uS
Reset to Stable Output Time	< 1 uS





I/O ENABLE JUMPERS

J1,J3,J5,J7,J9,J11,J13,J15
PORT WRITE DISABLE JUMPERS FACTORY ENABLED BY FOIL TRACE.
MAY BE DISABLED THROUGH SOFTWARE.

I/O PULL-UP JUMPERS

J2,J4,J6,J10
DOUBLE PORT PULL-UP VOLTAGE JUMPERS INSTALLED-PORT PULL-UP RESISTORS CONNECTED TO +5V.

VME BUS SHORT ADDRESS JUMPERS

JUMPER J19 PINS 3 & 4 - NO JUMPER INSTALLED - SELECTING SHORT MEMORY MAP. J18 HAS NO EFFECT ON BASE ADDRESS SELECTION.

	PINS ON J17					
BASE ADDRESS	S15 11 & 12	S14 10 & 9	S13 8 & 7	S12 6 & 5	S11 4 & 3	S10 2 & 1
0000H	OUT	OUT	OUT	OUT	OUT	OUT
0400H	OUT	OUT	OUT	OUT	OUT	IN
0800H	OUT	OUT	OUT	OUT	IN	OUT
F400H	IN	IN	IN	IN	OUT	IN
F800H	IN	IN	IN	IN	IN	OUT
FC00H	IN	IN	IN	IN	IN	IN

VME BUS STANDARD ADDRESS JUMPERS

JUMPER J19 PINS 3 & 4 - JUMPER INSTALLED - SELECTING STANDARD MEMORY MAP, J17 & J18 SELECT ON BASE ADDRESS.

	PINS ON J18							
BASE ADDRESS	S23 15 & 16	S22 13 & 14	S21 11 & 12	S20 9 & 10	S19 7 & 8	S18 5 & 6	S17 3 & 4	S16 1 & 2
00 0000H	OUT	OUT	OUT	OUT	OUT	OUT	OUT	OUT
01 0000H	OUT	OUT	OUT	OUT	OUT	OUT	OUT	IN
02 0000H	OUT	OUT	OUT	OUT	OUT	OUT	IN	OUT
03 0000H	OUT	OUT	OUT	OUT	OUT	OUT	IN	IN
FC 0000H	IN	IN	IN	IN	IN	IN	OUT	OUT
FD 0000H	IN	IN	IN	IN	IN	IN	OUT	IN
FE 0000H	IN	IN	IN	IN	IN	IN	IN	OUT
FF 0000H	IN	IN	IN	IN	IN	IN	IN	IN

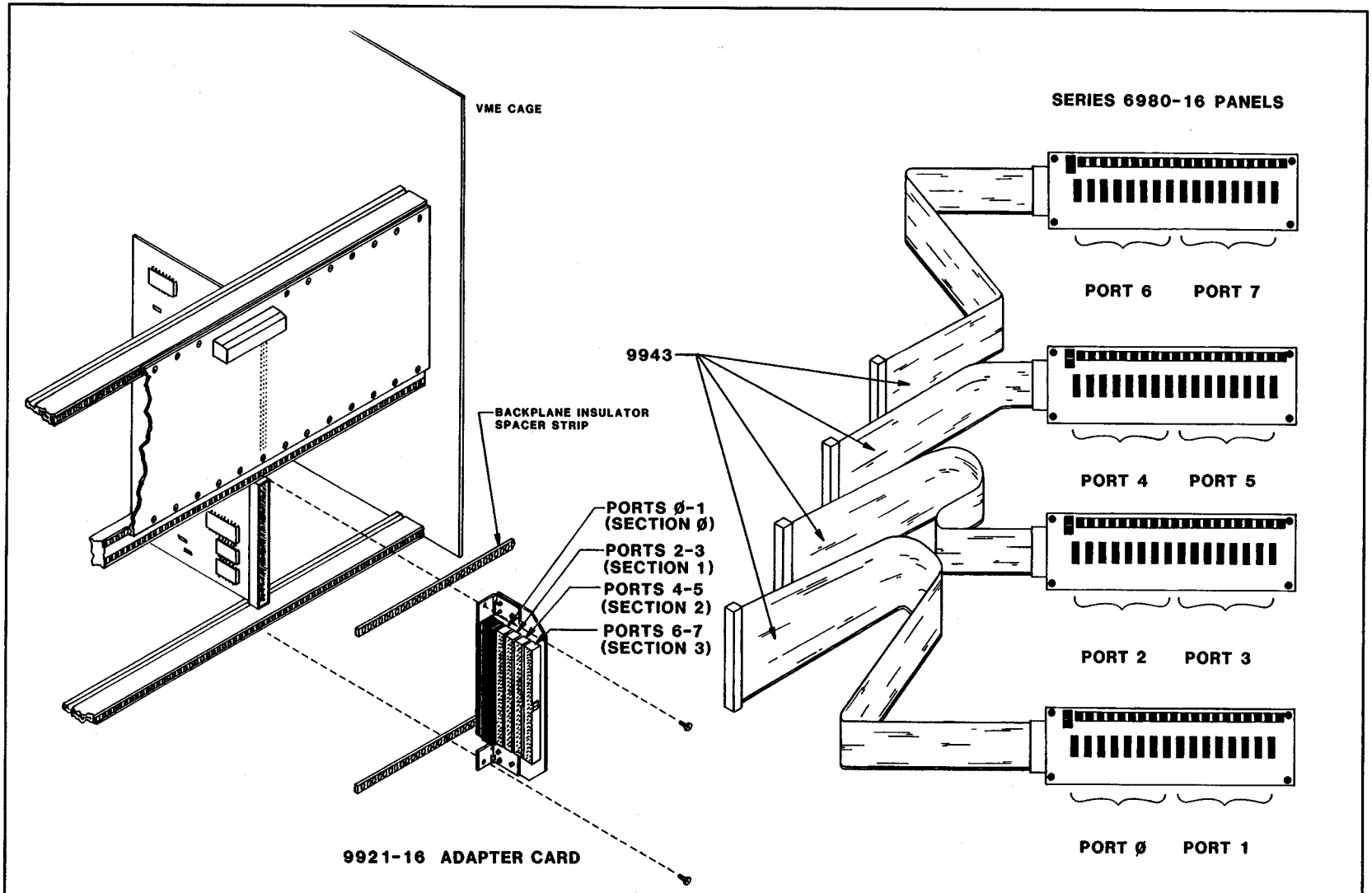
VME BUS SYSFAIL JUMPER

J20 SYSFAIL JUMPER
FACTORY INSTALLED BY FOIL TRACE
BOARD WILL ASSERT SYSFAIL AFTER POWER UP OR RESET.

VME BUS ADDRESS MODIFIER CODES

JUMPER J19 PINS 3 & 4	JUMPER J19 PINS 1 & 2	ADDRESS MODIFIER CODES RECOGNIZED	ADDRESSING MODE
OUT	OUT	2DH	SHORT SUPERVISORY
OUT	IN	2DH OR 29H	SHORT SUPERVISORY OR SHORT NON-PRIVELEDGED
IN	OUT	3DH	STANDARD SUPERVISORY
IN	IN	3DH OR 39H	STANDARD SUPERVISORY OR STANDARD NON-PRIVELEDGED

AcroMag® WIXOM, MICH.
MAR 88 | SK | DK
TITLE: JUMPER LOCATION
SIZE D | SERIES 941X / 946X | SHEET 1 OF 1 | DRAWING 4500-949 | REV



NOTE: 9921-16 ADAPTER CARD IS NOT P2 SAFE.

DO NOT PLUG THIS ADAPTER CARD INTO ANY P2 BACKPLANES IN A VME CAGE

DATE	REV	CO	DR	ENG	CLP
12 FEB 92	C	10099	MRM	JV	
24 OCT 91	B	10015	TAV		TH
13 AUG 90	A	9693	TAV		TH
18 APR 86	—	—	SJK	DW	—

Acromag® WIXOM, MICH.

TITLE: 9921-16 CONNECTION DIAGRAM

SIZE	SERIES	SHEET	DRAWING	REV
C DWG	AVME	1 OF 1	4500-790	C

3400-025

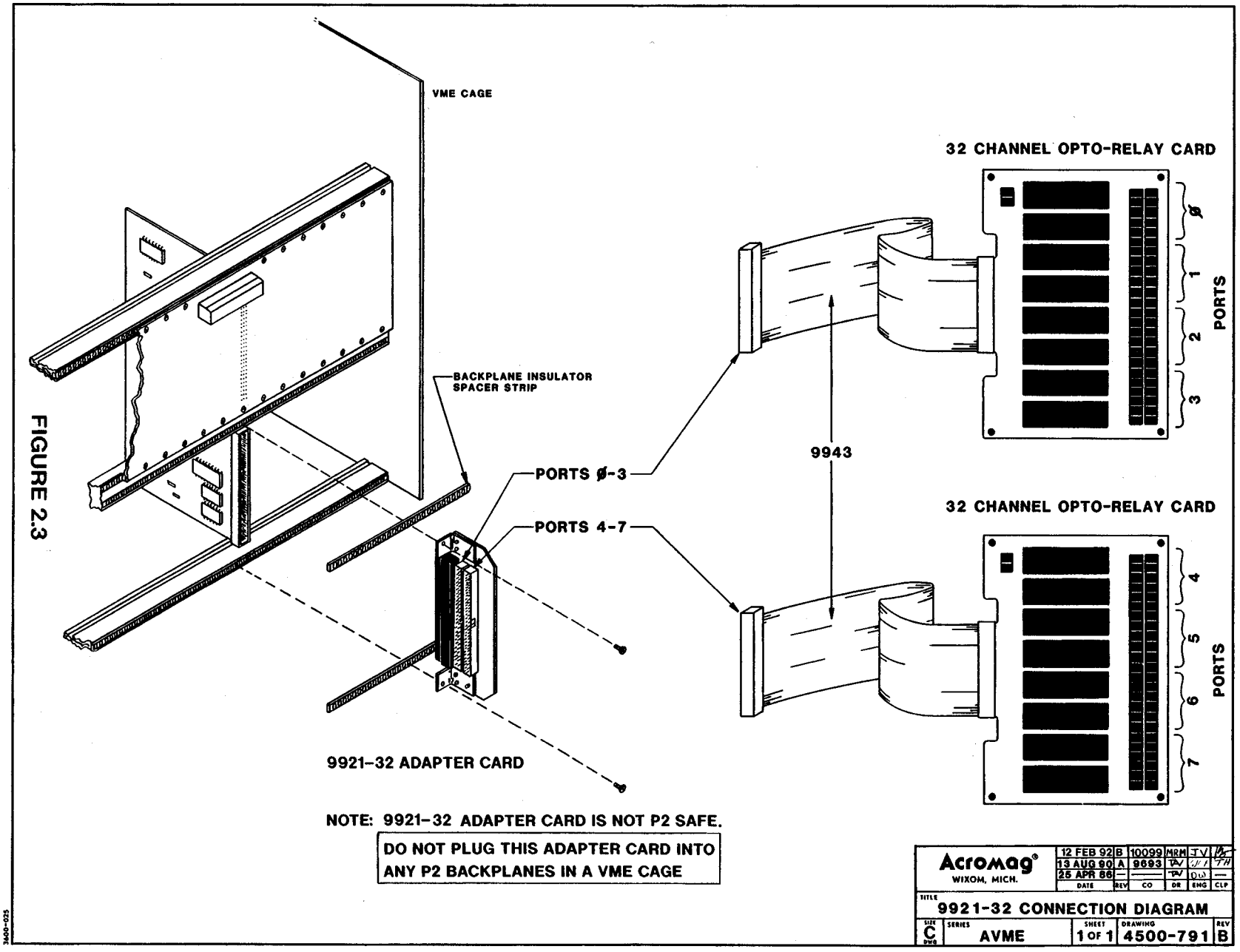

VME CAGE
32 CHANNEL OPTO-RELAY CARD
BACKPLANE INSULATOR SPACER STRIP
9943
PORTS Ø-3
PORTS 4-7
32 CHANNEL OPTO-RELAY CARD
PORTS
9921-32 ADAPTER CARD
NOTE: 9921-32 ADAPTER CARD IS NOT P2 SAFE.
DO NOT PLUG THIS ADAPTER CARD INTO ANY P2 BACKPLANES IN A VME CAGE
Acromag
WIXOM, MICH.
12 FEB 92 B 10099 MRM TV
13 AUG 90 A 9693 TV
25 APR 86 — TV
DATE REV CO DR ENG CLP
TITLE
9921-32 CONNECTION DIAGRAM
SIZE C DWG
SERIES AVME
SHEET 1 OF 1
DRAWING 4500-791
REV B

FIGURE 2.3

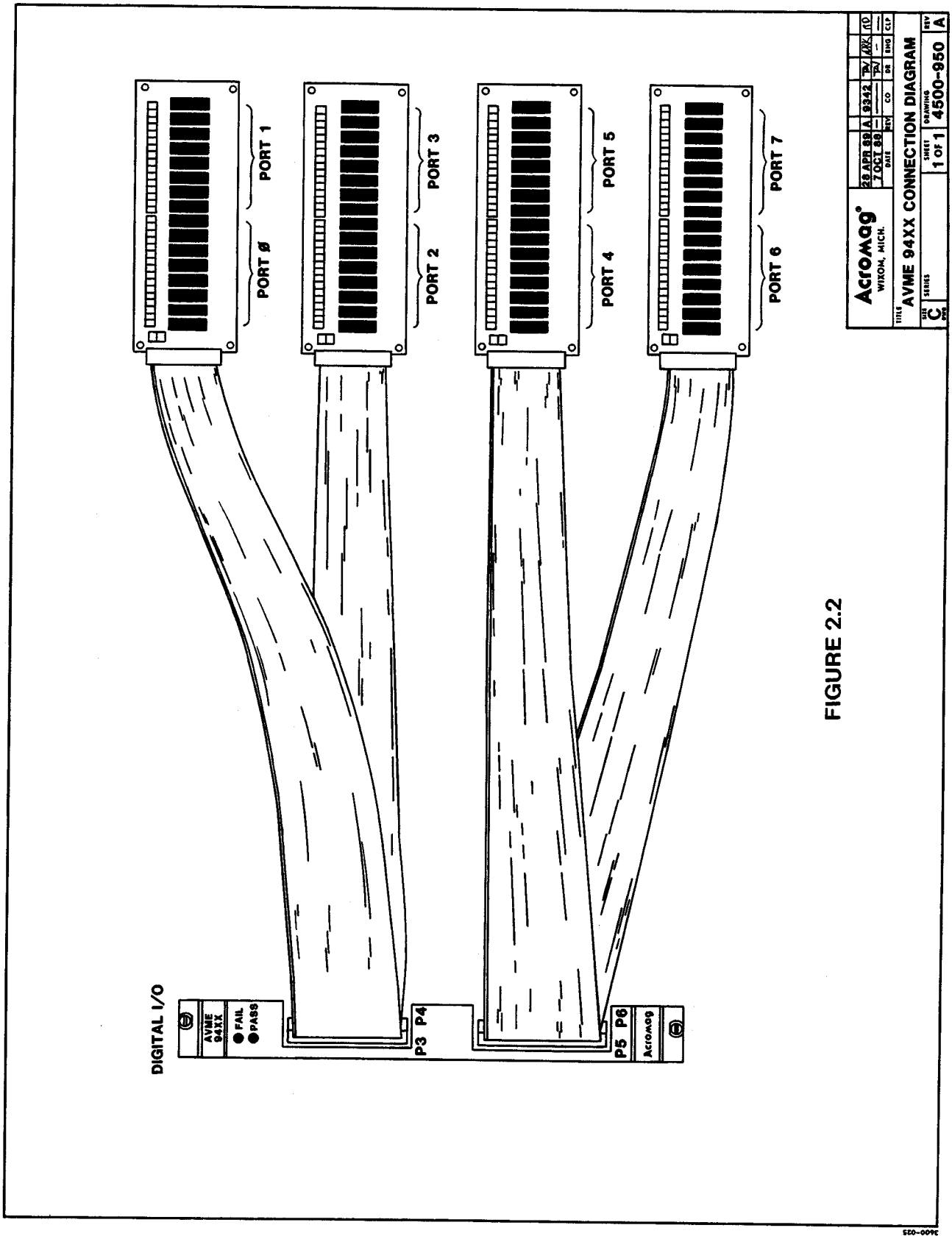

PORT 1
PORT Ø
PORT 3
PORT 2
PORT 5
PORT 4
PORT 7
PORT 6
DIGITAL I/O
AVME 94XX
FAIL
PASS
P3 P4
P5 P6
Acromag
Acromag
WIXOM, MICH.
AVME 94XX CONNECTION DIAGRAM
4500-950
A
1 OF 1

FIGURE 2.2

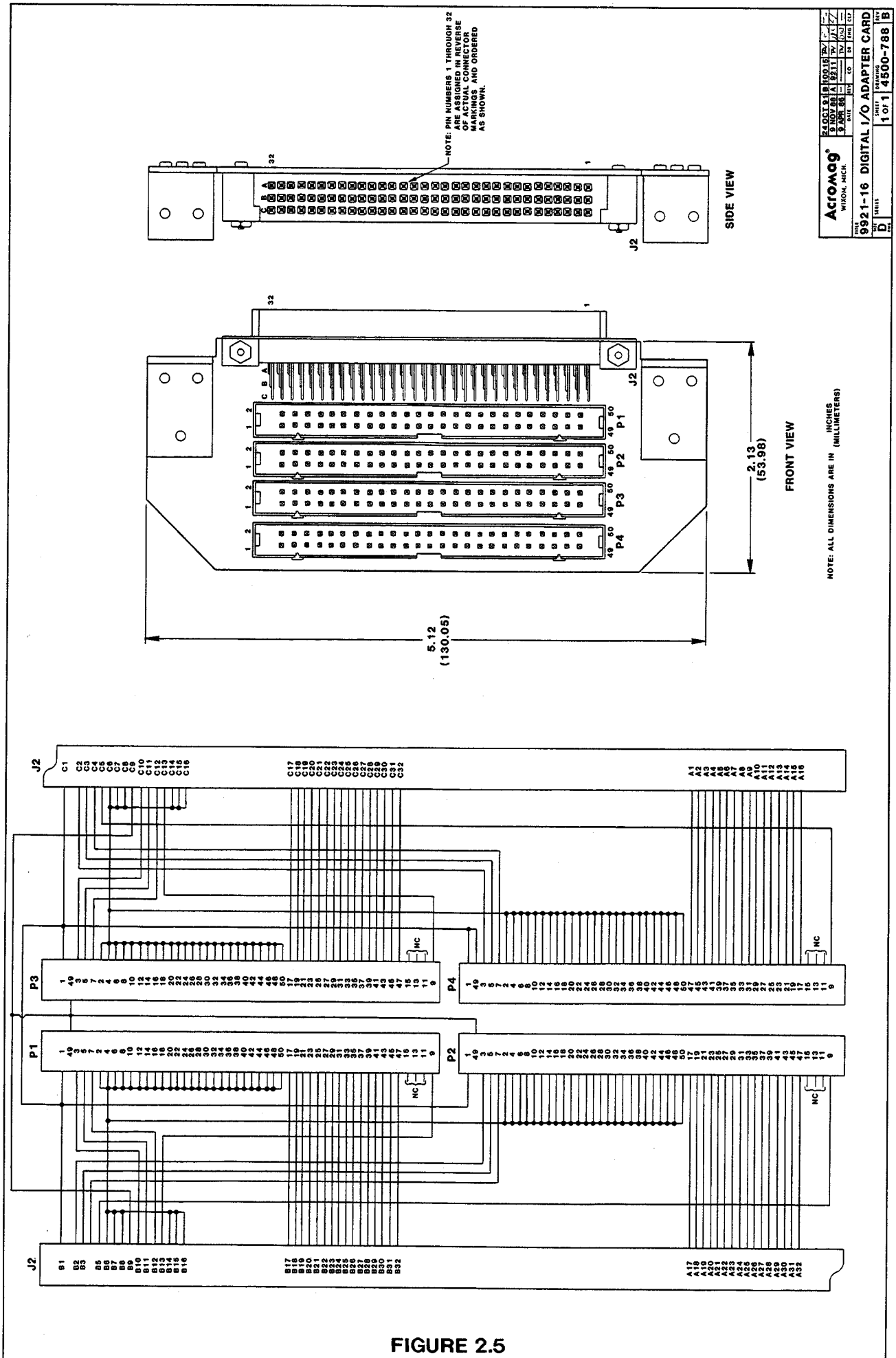

NOTE: PIN NUMBERS 1 THROUGH 32 ARE ASSIGNED IN REVERSE OF ACTUAL CONNECTOR MARKINGS AND ORDERED AS SHOWN.
SIDE VIEW
FRONT VIEW
NOTE: ALL DIMENSIONS ARE IN INCHES (MILLIMETERS)
2.13 (53.98)
5.12 (130.05)
Acromag WIXOM, MICH
9921-16 DIGITAL I/O ADAPTER CARD
4500-788
P1
P2
P3
P4
J2
NC

FIGURE 2.5

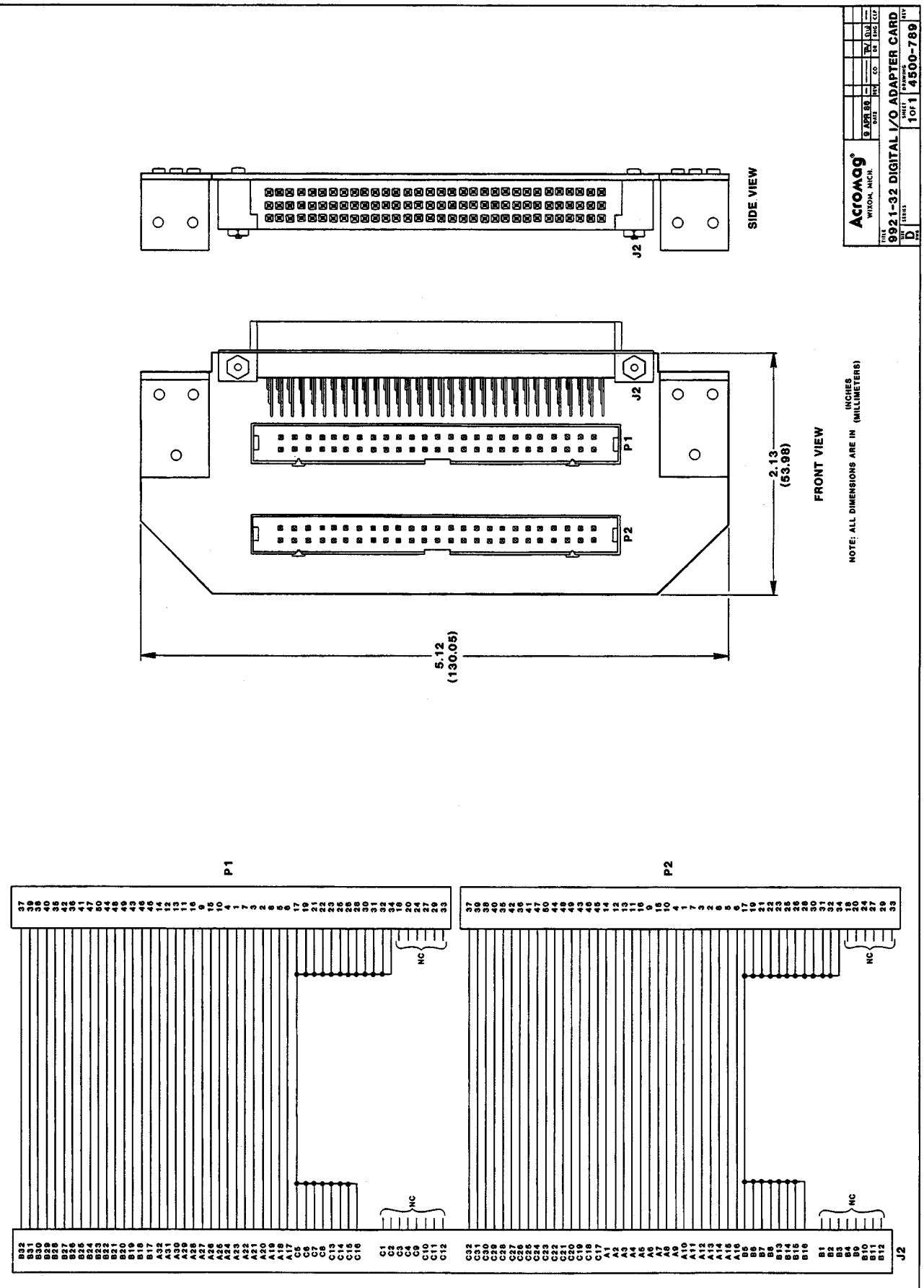
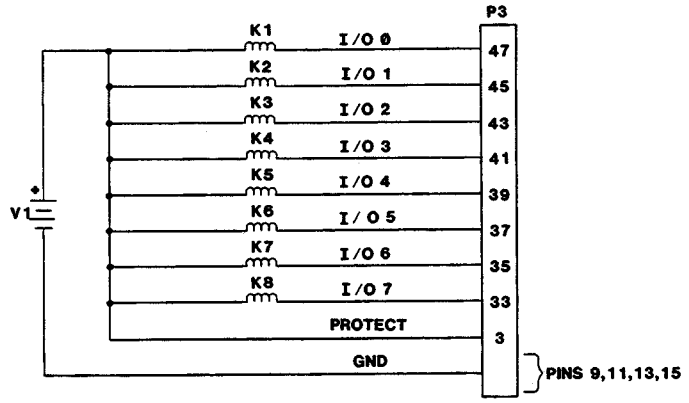
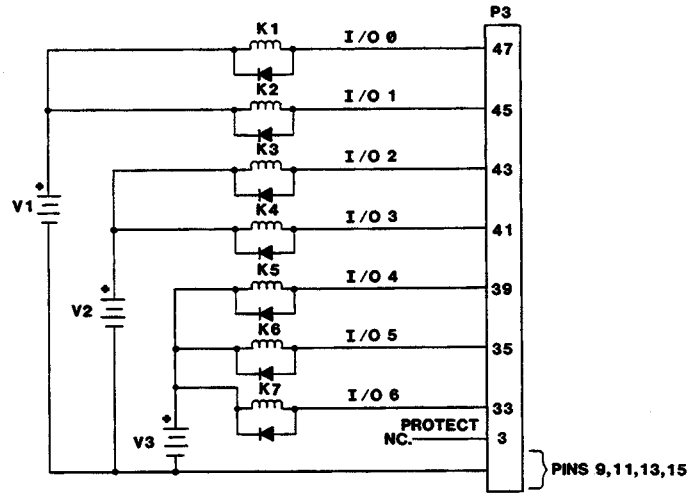

Acromag
WIXOM, MICH.
9 APR 96
DATE
DWN
CO
CK
ENG
CLK
TITLE
9921-32 DIGITAL I/O ADAPTER CARD
SIZE
D
SERIES
SHEET
1 OF 1
DRAWING
4500-789
REV
SIDE VIEW
J2
FRONT VIEW
J2
P1
P2
2.13
(53.98)
5.12
(130.05)
NOTE: ALL DIMENSIONS ARE IN INCHES
(MILLIMETERS)
P1
P2
NC
NC
NC
NC
J2

FIGURE 2.6

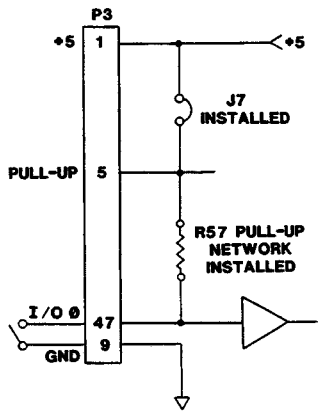


2.7A: COMMON SUPPLY- PROTECT LINE TIED TO V1, PUTS A PROTECTION DIODE ACROSS EACH RELAY.

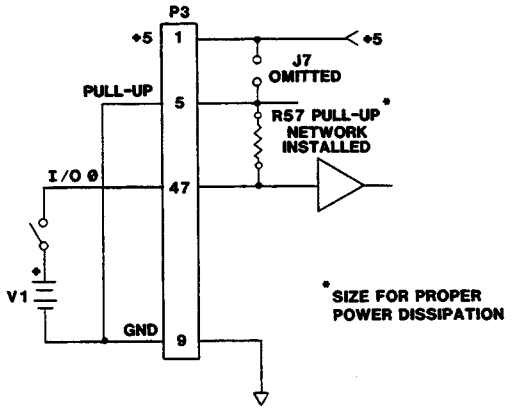


2.7B: SEPARATE SUPPLIES- EACH RELAY NEEDS ITS OWN EXTERNAL DIODE.

FIGURE 2.7: RELAY DRIVER CONFIGURATIONS
(SHOWN FOR PORTS N & 0)



2.8A: SIMPLE CONTACT CLOSURE SENSING.



2.8B: CONTACTS SWITCHING A VOLTAGE.

FIGURE 2.8: INPUT CONFIGURATIONS
(SHOWN FOR PORTS N & 0, I/O POINT 0)

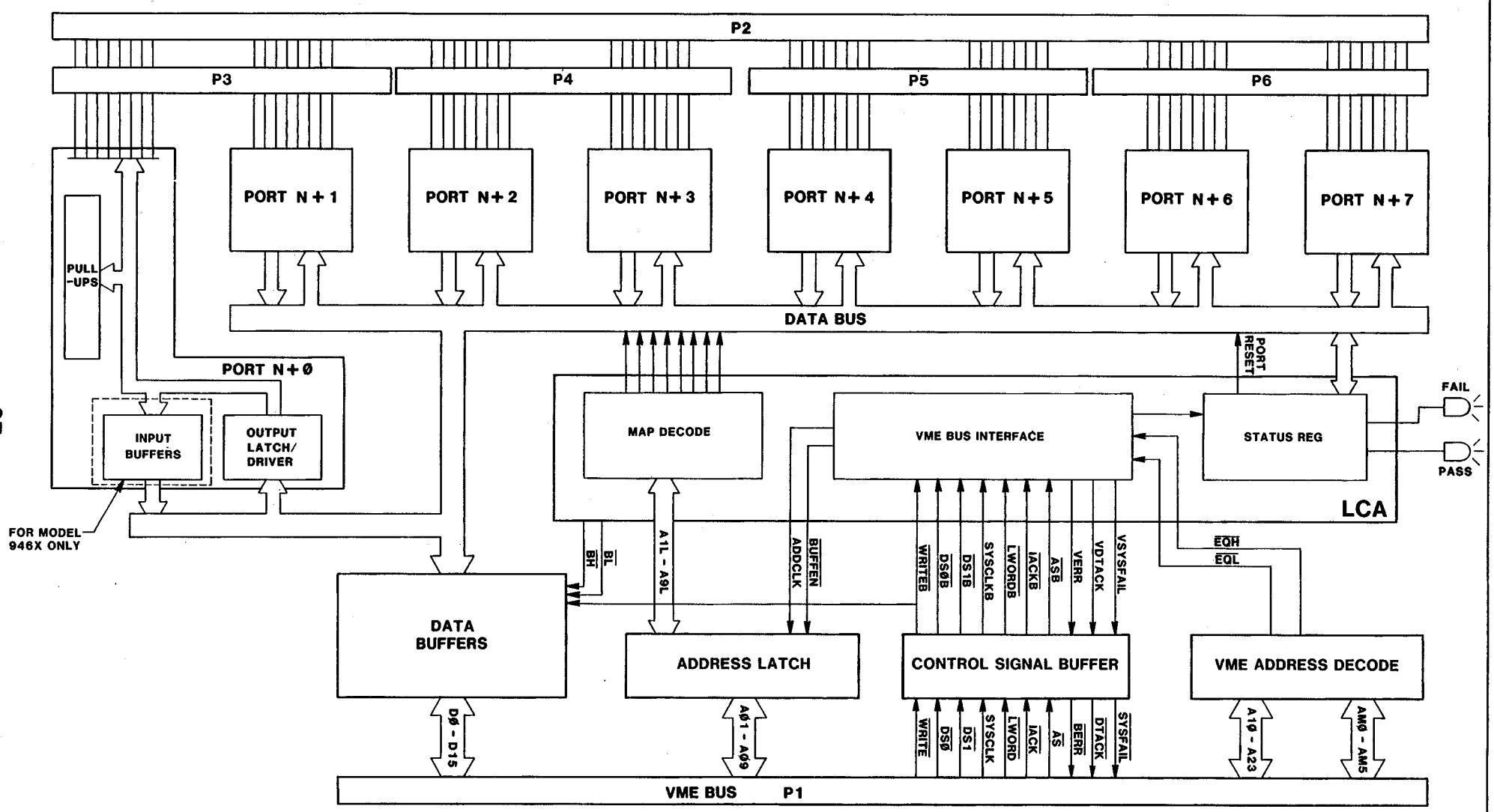


FIGURE 4.1: AVME 946X / 941X BLOCK DIAGRAM

Acromag WIXOM, MICH.	9 JUNE 88			SJK		
	DATE	REV	CO	DR	ENG	CLP
TITLE: AVME 946X / 941X BLOCK DIAGRAM						
SIZE D	SERIES 946X / 941X	SHEET 1 OF 1	DRAWING 4500-948	REV		

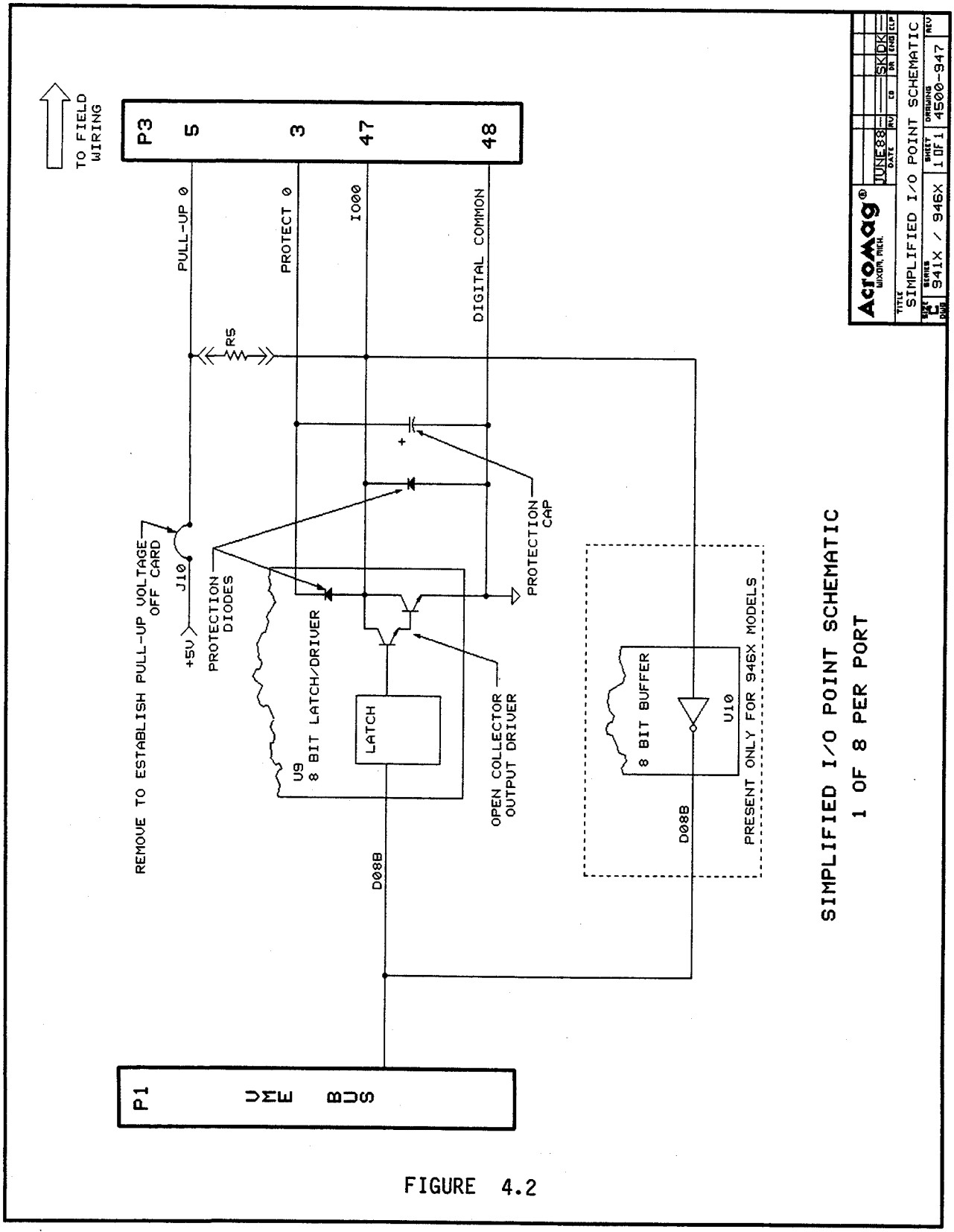
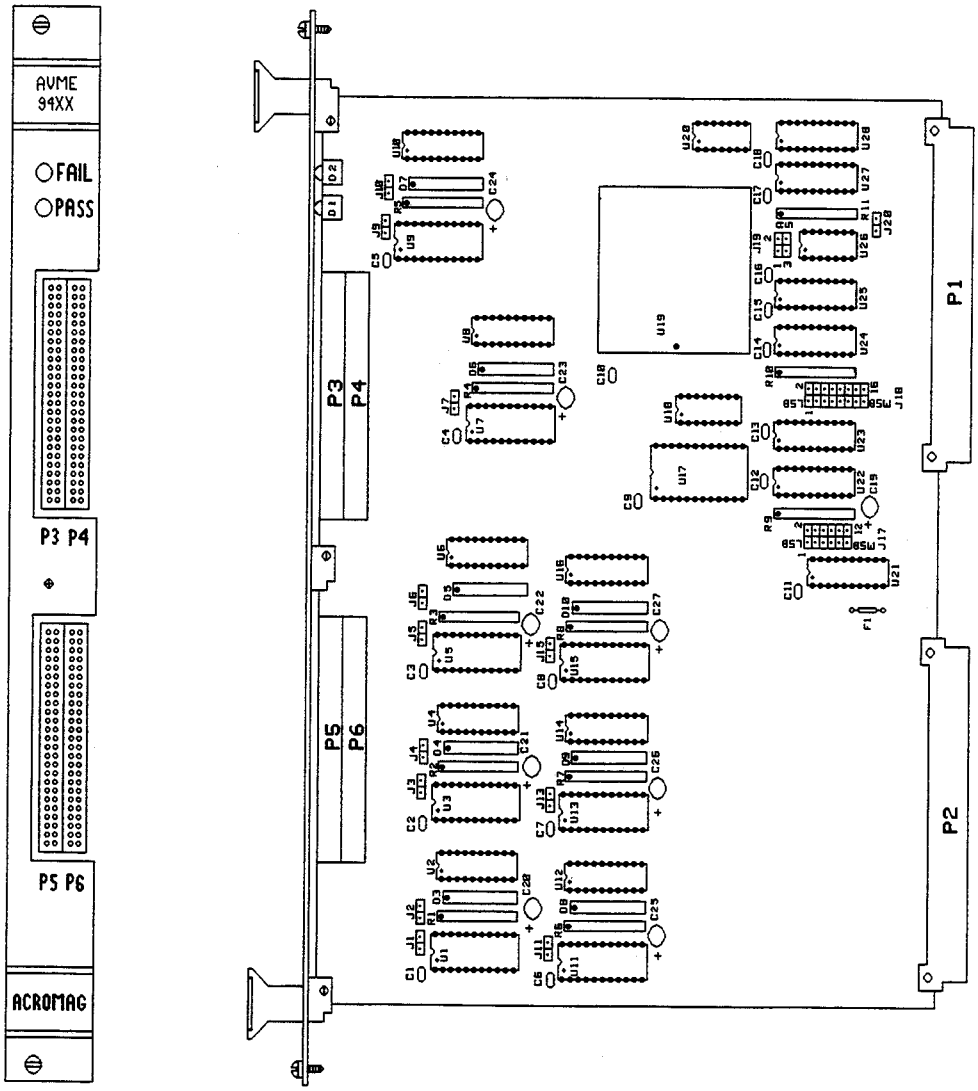
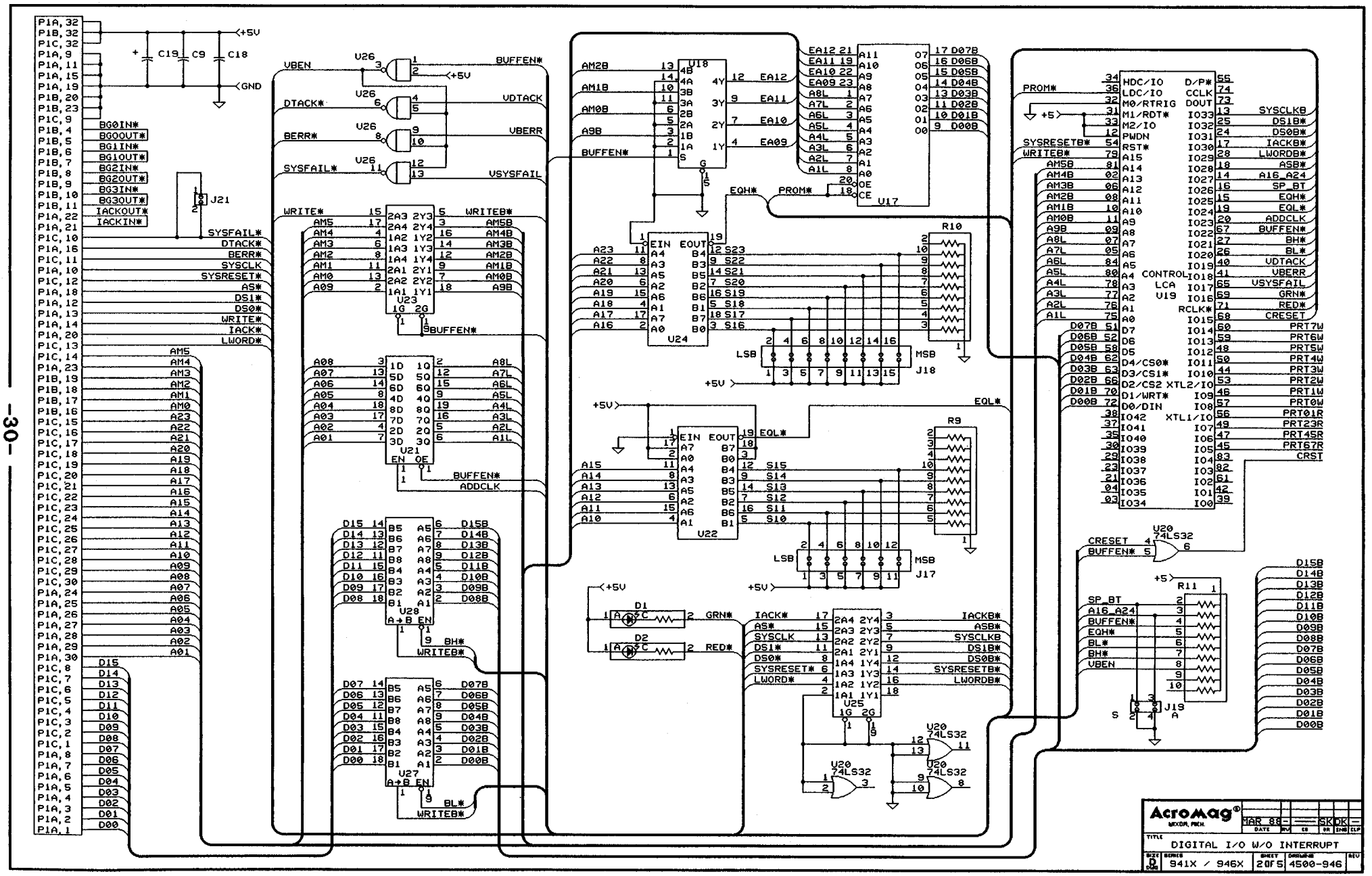
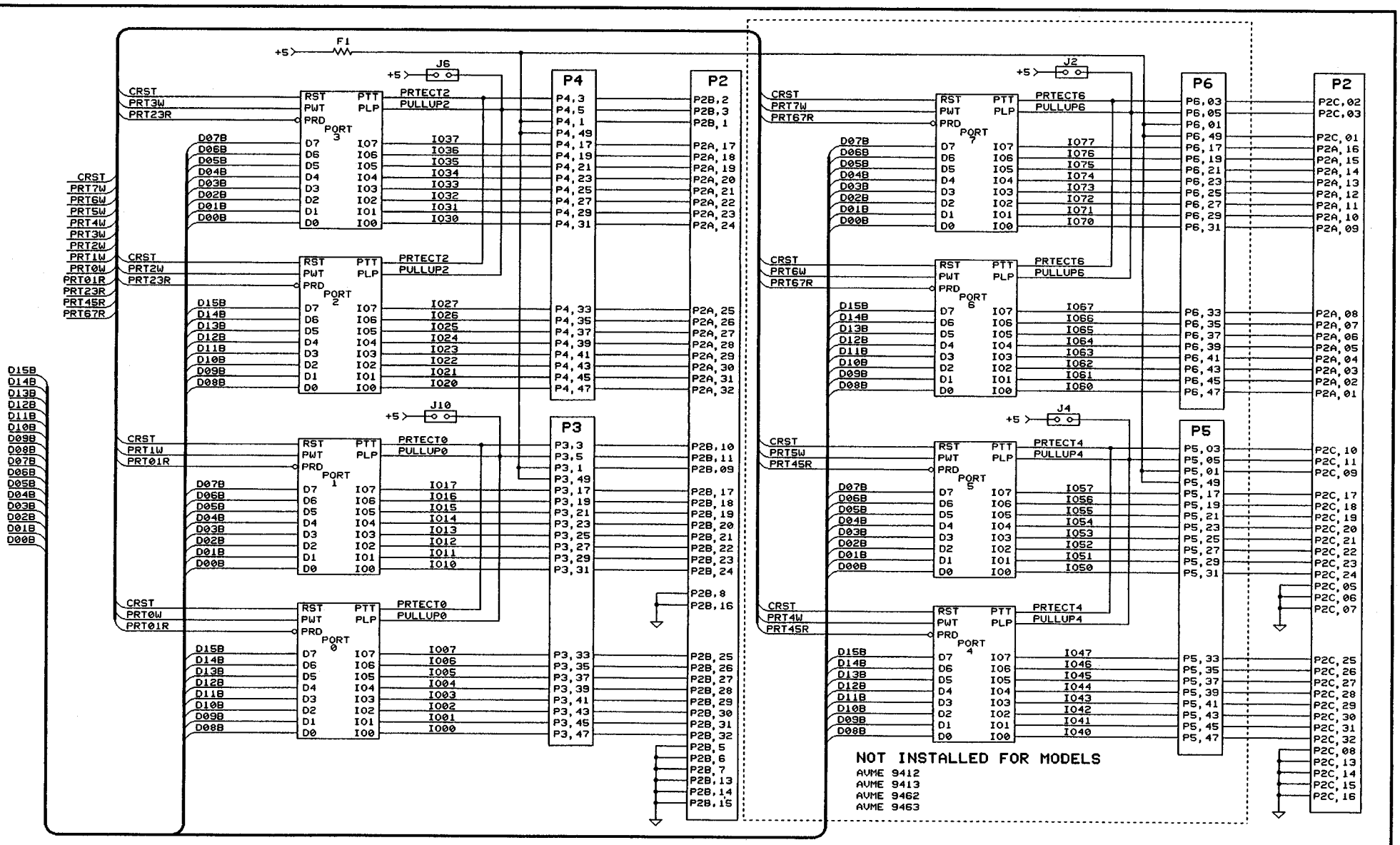

TO FIELD WIRING
P3
5
3
47
48
PULL-UP 0
PROTECT 0
I000
DIGITAL COMMON
RS
+
PROTECTION CAP
REMOVE TO ESTABLISH PULL-UP VOLTAGE OFF CARD
J10
+5V
PROTECTION DIODES
U9
8 BIT LATCH/DRIVER
LATCH
OPEN COLLECTOR OUTPUT DRIVER
D08B
8 BIT BUFFER
U10
D08B
PRESENT ONLY FOR 946X MODELS
P1
Acromag
WIXOM, MICH.
JUNE 88
DATE
SK
DK
DR
ENG
CLP
TITLE
SIMPLIFIED I/O POINT SCHEMATIC
SIZE
C
DWG
SHEET
1 OF 1
DRAWING
4500-947
REV
SIMPLIFIED I/O POINT SCHEMATIC
1 OF 8 PER PORT

FIGURE 4.2



AcroMag
MAR 88
DIGITAL I/O W/O INTERRUPT
941X / 946X
1 OF 5
4500-946


P1A, 32
P1B, 32
P1C, 32
P1A, 9
P1A, 11
P1A, 15
P1A, 19
P1B, 20
P1B, 23
P1C, 9
P1B, 4
P1B, 5
P1B, 6
P1B, 7
P1B, 8
P1B, 9
P1B, 10
P1B, 11
P1A, 22
P1A, 21
P1C, 10
P1A, 16
P1C, 11
P1A, 10
P1C, 12
P1A, 18
P1A, 12
P1A, 13
P1A, 14
P1A, 20
P1C, 13
P1C, 14
P1A, 23
P1B, 19
P1B, 18
P1B, 17
P1B, 16
P1C, 15
P1C, 16
P1C, 17
P1C, 18
P1C, 19
P1C, 20
P1C, 21
P1C, 22
P1C, 23
P1C, 24
P1C, 25
P1C, 26
P1C, 27
P1A, 28
P1C, 29
P1C, 30
P1A, 24
P1A, 25
P1A, 26
P1A, 27
P1A, 28
P1A, 29
P1A, 30
P1C, 8
P1C, 7
P1C, 6
P1C, 5
P1C, 4
P1C, 3
P1C, 2
P1C, 1
P1A, 8
P1A, 7
P1A, 6
P1A, 5
P1A, 4
P1A, 3
P1A, 2
P1A, 1
+5V
GND
C19
C9
C18
BG0IN*
BG0OUT*
BG1IN*
BG1OUT*
BG2IN*
BG2OUT*
BG3IN*
BG3OUT*
IACKOUT*
IACKIN*
J21
SYSFAIL*
DTACK*
BERR*
SYSCLK
SYSRESET*
AS*
DS1*
DS0*
WRITE*
IACK*
LWORD*
AM5
AM4
AM3
AM2
AM1
AM0
A23
A22
A21
A20
A19
A18
A17
A16
A15
A14
A13
A12
A11
A10
A09
A08
A07
A06
A05
A04
A03
A02
A01
D15
D14
D13
D12
D11
D10
D09
D08
D07
D06
D05
D04
D03
D02
D01
D00
VBEN
DTACK*
BERR*
SYSFAIL*
U26
BUFFEN*
VDTACK
VBERR
VSYSFAIL
WRITE*
AM5
AM4
AM3
AM2
AM1
AM0
A09
U23
WRITEB*
AM5B
AM4B
AM3B
AM2B
AM1B
AM0B
A9B
A08
A07
A06
A05
A04
A03
A02
A01
U21
A8L
A7L
A6L
A5L
A4L
A3L
A2L
A1L
ADDCLK
D15
D14
D13
D12
D11
D10
D09
D08
U28
BH*
D07
D06
D05
D04
D03
D02
D01
D00
U27
BL*
AM2B
AM1B
AM0B
A9B
U18
EA12
EA11
EA10
EA09
EQH*
PROM*
U24
R10
LSB
MSB
J18
U22
R9
J17
D1
D2
GRN*
RED*
IACK*
AS*
SYSCLK
DS1*
DS0*
SYSRESET*
LWORD*
U25
U17
EA12
EA11
EA10
EA09
A8L
A7L
A6L
A5L
A4L
A3L
A2L
A1L
D07B
D06B
D05B
D04B
D03B
D02B
D01B
D00B
U20
74LS32
IACKB*
ASB*
SYSCLKB
DS1B*
DS0B*
SYSRESETB*
LWORDB*
PROM*
SYSRESETB*
WRITEB*
HDC/IO
LDC/IO
M0/RTRIG
M1/RDT*
M2/IO
PWDN
RST*
D/P*
CCLK
DOUT
CONTROL
LCA
U19
RCLK*
XTL2/IO
XTL1/IO
SYSCLKB
DS1B*
DS0B*
IACKB*
LWORDB*
ASB*
A16_A24
SP_BT
EQH*
EQL*
ADDCLK
BUFFEN*
BH*
BL*
VDTACK
VBERR
VSYSFAIL
GRN*
RED*
CRESET
PRT7W
PRT6W
PRT5W
PRT4W
PRT3W
PRT2W
PRT1W
PRT0W
PRT01R
PRT23R
PRT45R
PRT67R
CRST
R11
J19
VBEN
AcroMag
MIXDA, MICH.
MAR 88
SK DK
DIGITAL I/O W/O INTERRUPT
SIZE D
SERIES 941X / 946X
SHEET 2 OF 5
DRAWING 4500-946
REV

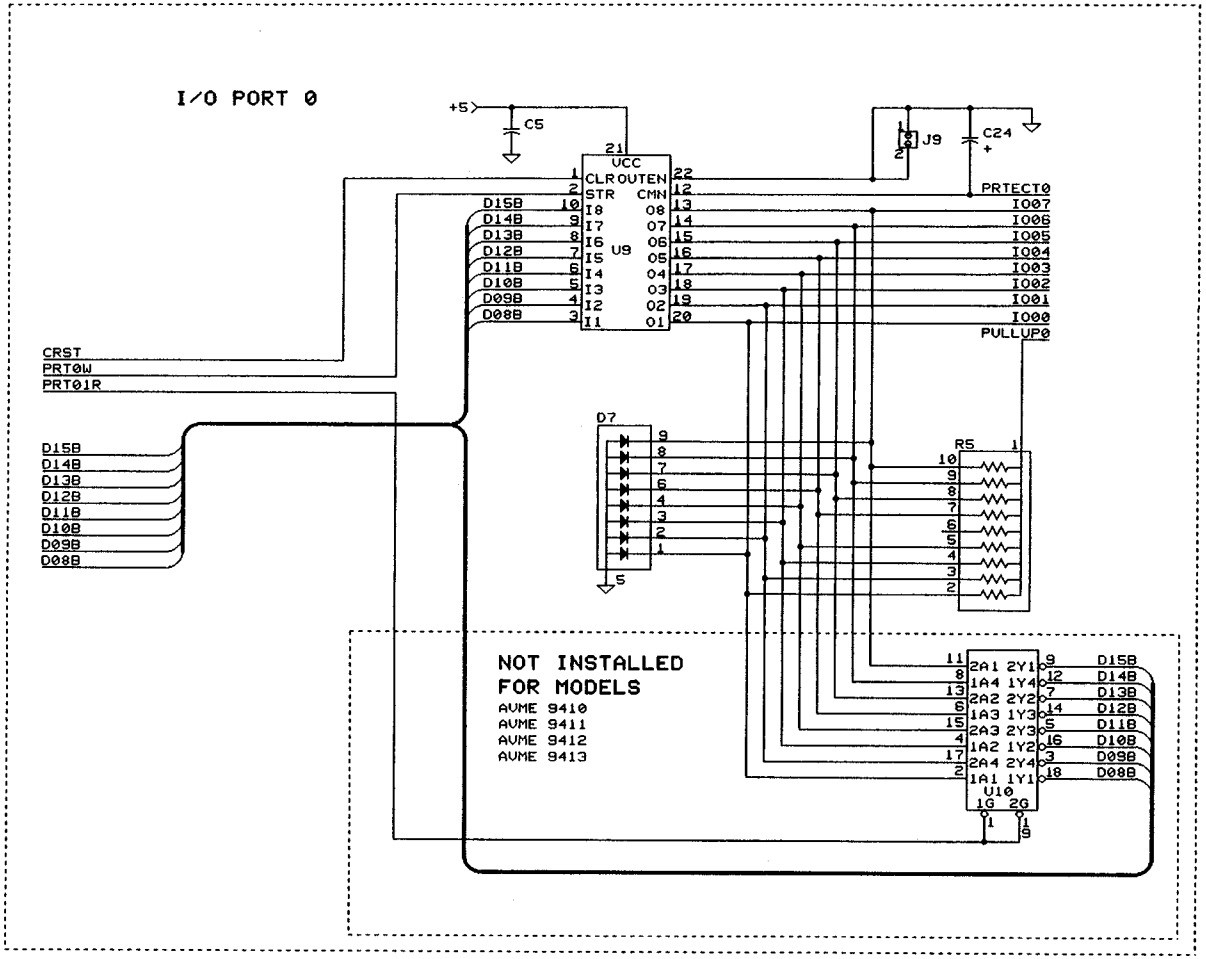


NOTE: CONNECTORS P3,P4,P5,P6,ALL EVEN PINS GROUNDED.

Acromag® WIXOM, MICH.				MAR 88		SKOK
				DATE	REV	ED DR ENG CLP
TITLE: DIGITAL I/O W/O INTERRUPT						
SIZE: D	SCALE: 941X / 946X		SHEET: 3 OF 5	DRAWING: 4500-946		REV

COMPONENT DESIGNATIONS FOR ALL EVEN I/O PORTS

I/O PORT 0	U9	U10	J9	D7	R5	C5	C24
I/O PORT 2	U5	U6	J5	D5	R3	C3	C27
I/O PORT 4	U3	U4	J3	D4	R2	C2	C21
I/O PORT 6	U1	U2	J1	D3	R1	C1	C20



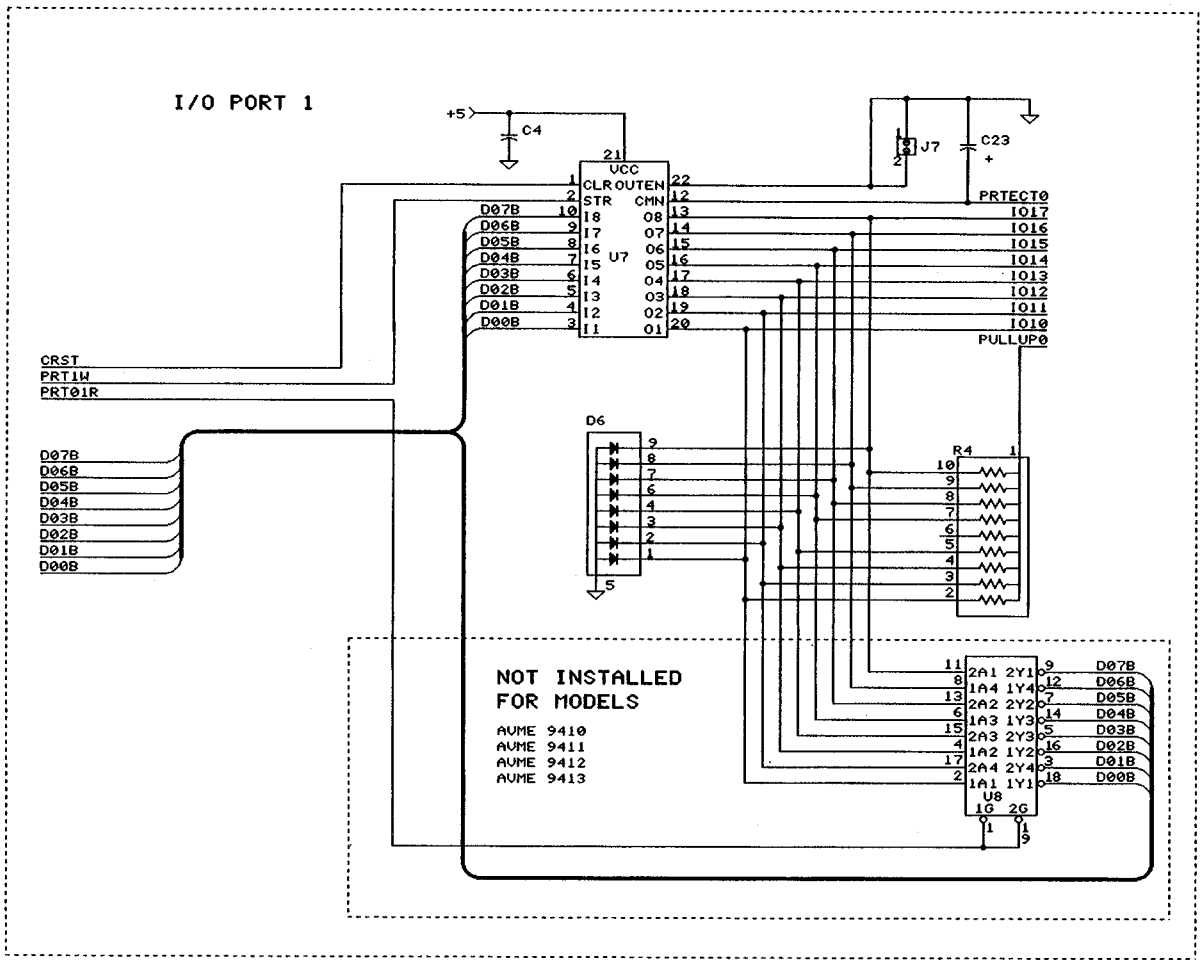
AcroMag® WIXOM, MICH. — MAR 88 — SK DK

TITLE: DIGITAL I/O W/O INTERRUPT

SIZE D — BOARD 941X / 946X — SHEET 4 OF 5 — DRAWING 4500-946 — REV

COMPONENT DESIGNATIONS FOR ALL ODD I/O PORTS

I/O PORT 1	U7	U8	J7	D6	R4	C4	C23
I/O PORT 3	U15	U16	J15	D10	R8	C8	C22
I/O PORT 5	U13	U14	J13	D9	R7	C7	C26
I/O PORT 7	U11	U12	J11	D8	R6	C6	C25



AcroMag® MIDDLEFIELD, OHIO

	DATE	BY	CO	ENG	CLP
	MAR 88	–	–	SK	DK

TITLE: DIGITAL I/O W/O INTERRUPT

SIZE	SERIES	SHEET	DRAWING NO.	REV
D	941X / 946X	5 OF 5	4500-946	